through those parasitic capacitances and hence has little effect on the ultimate measurement.

[0049] Yet another approach for addressing the above-noted problems includes reducing crosstalk between pixels. Electrical crosstalk between adjacent pixel sensing traces **33** can cause errors and loss of resolution. Crosstalk between pixels can be caused by capacitive coupling or inductive coupling. By forcing the pixel sensing traces **33** (both active and inactive) to remain at the same reference potential, no capacitive energy transfer between pixels can take place, hence capacitive crosstalk is reduced.

[0050] In inductive crosstalk, currents flowing in one pixel sensing trace **33** induce a voltage in adjacent pixel sensing traces. The induced crosstalk voltage is based upon the first derivative (rate of change) of the inducing current. Most excitation waveforms used in sensing (e.g., a step waveform) cause the current in the pixel sensing trace **33** to initially increase, and then decrease as the charge on the flux sensor balances. Since the induced voltage follows the derivative of the current, the voltage may have one polarity during the time the current is increasing and the opposite polarity during the time the current is decreasing. If the flux sensors' amplifiers integrate over the full pixel charging period, the induced crosstalk signal integrates to a value very close to zero. Hence the effects of inductive crosstalk may be reduced.

[0051] Referring now to FIGS. **4-6**, another embodiment of a fingerprint sensor **30'** is illustrated. The pixel sensing traces **33'** and the fingerprint sensor IC **31'** are bonded to a thin insulating substrate **34'**. Power and signal connections for the fingerprint sensor **30'** are on bond pads **37'**. The finger sensing area **32'** is defined by two rows of pixels with the pixel sensing traces **33'** routed to the finger sensing area at both the top and the bottom. The first or lower metalization layer is beneath the layer of finger drive/shield electrodes **35'**.

[0052] The switchable finger drive/shield electrodes **35'** are bonded to the top of the thin insulating substrate **34'** (FIG. **5**). In this example there are six different electrodes that can be switched to perform the functions of finger drive, or finger shield as desired. The overlaid relationship of the drive/shield electrodes **34'** and the pixel sensing traces **33'** is illustrated in FIG. **6**.

[0053] Illustratively, the finger sensing area **32'** is structured as two parallel linear rows of pixels. When the user's finger **60** moves across the array or the pixels, image frames two rows high can be captured. Known methods of finger movement estimation, image reconstruction, and image normalization can be applied to the two row geometry. For example, some of these methods are disclosed in U.S. Pat. No. 7,809,211, to Taraba et al., having a common assignee, and the entire contents of which are herein incorporated by reference.

[0054] Referring now additionally to FIGS. **7** and **8**, different alternate sensing region array geometries are also possible. The finger sensing pixel array has four rows of pixels in the finger sensing area **32"** in a staggered pattern. This type of sensor pattern can often be used with simpler and more robust finger movement estimation methods than the two row pattern, for example.

[0055] The four rows of pixels are separated into two pairs to illustrate the use of an optional field smoothing electrode **48"** between the upper and lower pairs of rows. Of course, the four rows of pixels may be spaced at even distances vertically. Use of a field smoothing electrode **48"** may improve the consistency of the pixel signals, but this may generally occur at the cost of changing the spacing between the rows. The value of this trade-off may depend upon the finger movement estimating methods used to reconstruct the finger image, as will be appreciated by those skilled in the art.

[0056] The drive/shield electrodes **35** "are shaped to follow the staggered pixel pattern. Indeed, is may also be possible to build structures where the pixel sensing traces **33**" approach the finger sensing area **32"** from the same direction. For example, the bottom half of FIG. **6**, by itself may be used as a two row sensor. Elaborating on this design, it is also possible to build geometries where switching of the finger drive/shield electrodes **35"** may not be desired. If all electrodes approach the finger sensing area **32"** from one direction as discussed above, an unswitched finger drive electrode can be placed on the other side of the finger sensing area. This approach may be used in certain circumstances where the one sided geometry can be supported.

[0057] The fingerprint sensor **30** described herein may allow a variety of different types of measurements to be made. In the simplest system, each pixel sensing trace **33** may be measured and its signal becomes the pixel value of that location in the resulting fingerprint image frame. In one alternative approach, 2-dimensional differential signals may be acquired by making differential measurements between adjacent pixels both horizontally and vertically. The resulting signals can be beneficially used to construct more accurate fingerprint images as described in U.S. application Ser. No. 13/269,316 to Setlak et al., having a common assignee, and the entire contents of which are herein incorporated by reference.

[0058] It is worthy of noting that prior art fingerprint sensing systems having the finger sensing area separate from the sensor IC are generally not capable of accurately performing 2-dimensional differential measurements, which severely limits image quality capability in this regard.

[0059] In some situations it may be desirable to have the finger sensing area as part of a standard touch screen display, for example. In those cases, when the fingerprint function is not active, it may be desirable for the fingerprint sensing region to function as a normal part of the touch sensing user input area. Typical touch sensing mechanisms use an array of capacitive sensing plates to locate the position of the finger on the display. The touch sensing pixels are much larger than fingerprint sensing pixel. Thus, the electrodes used for finger drive/shield purposes in fingerprint sensing can be also used as touch sensing pixels when the fingerprint reading function is inactive.

[0060] Referring now to FIGS. **9** and **10**, another embodiment may allow the drive/shield electrodes **35'''** around the finger sensing area **32'''** to function as sensing elements in a capacitive touchscreen sensing system when the fingerprint capture function is inactive. The four electrodes **35*a*'''-35*d*'''** act as capacitive touch sensor pixels. The area around the fingerprint sensing IC **31'''** would be off to the side of the active touchscreen area and may not participate in the touch sensing function. FIG. **10** shows this drive/shield electrode structure over the top of an arrangement of pixel sensing traces **33'''**.

[0061] A related method may include a method of making a finger sensor as described above. Another method aspect may be directed to a method of sensing a fingerprint, for example, through a display, as described above.

[0062] Many modifications and other embodiments of the invention will come to the mind of one skilled in the art having